State of California
The Resources Agency
Department of Water Resources

MATRIX OF LIFE HISTORY AND HABITAT REQUIREMENTS FOR FEATHER RIVER FISH SPECIES SP-F3.2 TASK 2

BLACK CRAPPIE

Oroville Facilities Relicensing
FERC Project No. 2100

APRIL 2004

ARNOLD SCHWARZENEGGER
Governor
State of California

MIKE CHRISMAN
Secretary for Resources
The Resources Agency

LESTER A. SNOW
Director
Department of Water Resources

State of California
The Resources Agency
Department of Water Resources

MATRIX OF LIFE HISTORY AND HABITAT REQUIREMENTS FOR FEATHER RIVER FISH SPECIES SP-F3.2 TASK 2

BLACK CRAPPIE

Oroville Facilities Relicensing
FERC Project No. 2100

This report was prepared under the direction of

Terry J. Mills ..... Environmental Program Manager I, DWR

by

Paul Bratovich ..... Principal/Fisheries Technical Lead, SWRI
David Olson ..... Senior Environmental Scientist/Project Manager, SWRI
Adrian Pitts ..... Associate Environmental Scientist/Author, SWRI
Meryka Atherstone ..... Associate Environmental Planner/Author, SWRI
Allison Niggemyer ..... Associate Environmental Scientist/ Author, SWRI
Amanda O'Connell ..... Environmental Planner/Author, SWRI
Karen Riggs ..... Environmental Planner/Author, SWRI
Brian Ellrott ..... Environmental Scientist/Author, SWRI

Element	Element Descriptor	General	Feather River Specific
General			
common name (s)	English name (usually used by fishers and laypeople).	Black Crappie	
scientific name (s)	Latin name (referenced in scientific publications).	The scientific name of black crappie is *Pomoxis nigromaculatus* (Moyle 2002)	
taxonomy (family)	Common name of the family to which they belong. Also indicate scientific family name.	Black crappie belong to the *Centrarchidae* (i.e., sunfish) family (Moyle 2002)	
depiction	Illustration, drawing or photograph.		
range	Broad geographic distribution, specifying California distribution, as available.	Black crappie were originally distributed throughout the Mississippi River basin from Quebec, Ontario, and Manitoba southward, throughout the Great Lakes basin, south to the Rio Grande River and Gulf Coast drainages into Texas, and in the Gulf and Atlantic coast drainages north to Virginia, including Florida (Moyle 2002). The native range of black crappie is in eastern and central North America, including the Great Lakes; from Florida west to the Gulf Coast and Alabama, and north along the Atlantic Coast to Virginia (Wang 1986).	
native or introduced	If introduced, indicate timing, location, and methods.	Black crappie have been successfully introduced into reservoirs and lakes throughout the United States, southern Canada, northern Mexico, Guatemala, and Panama. The exact date of introduction into California is uncertain because of confusion between the two crappie species, but 1908 is reportedly the most likely year, with introduction of black crappie from Illinois into reservoirs in southern California. Black crappie were transplanted to the Central Valley in either 1916 or 1919 (or both) and quickly became abundant. Black crappie were established in the Colorado River by the 1940s. They are now well established mainly in reservoirs, in all major basins of California, except the upper Klamath basin and few Great Basin watersheds. They can be expected anywhere in the state where there is warm, quiet	

Element	Element Descriptor	General	Feather River Specific
		water (Moyle 2002). Black crappie were introduced into California in 1908 (Wang 1986).	
ESA listing status	Following the categories according to California Code of Regulations and the Federal Register, indicate whether: SE = State-listed Endangered; ST =State-listed Threatened; FE = Federally listed Endangered; FT = Federally-listed Threatened; SCE = State Candidate (Endangered); SCT = State candidate (Threatened); FPE = Federally proposed (Endangered); FPT = Federally proposed (Threatened); FPD = Federally proposed (Delisting); the date of listing; or N = not listed.	Black crappie are not a listed species (DFG 2002).	
species status	If native, whether: Extinct/extirpated; Threatened or Endangered; Special concern; Watch list; Stable or increasing. If introduced, whether: Extirpated (failed introduction); highly localized; Localized; Widespread and stable; Widespread and expanding.	Black crappie are a freshwater fish and their status is widespread and stable (Moyle 2002).	
economic or recreational value	Indicate whether target species sought for food or trophy. Whether desirable by recreational fishers, commercial fishers, or both.	Black crappie are a popular game fish in California lakes and reservoirs (Moyle 2002).	
warmwater or coldwater	Warmwater if suitable temperature range is similar to basses; coldwater if suitable temperature range is similar to salmonids.		
pelagic or littoral	Environment: Pelagic - living far from shore; Littoral - living near the shore.	Black crappie are reportedly usually found in highly localized shoals around large submerged objects during the day, but move off shore (or inshore if prey are abundant) in the evening and early morning (Moyle 2002).	

Element	Element Descriptor	General	Feather River Specific
bottom or water column distribution	Environment: bottom (benthic) or along water column.	Black crappie are reportedly distributed along the water column (Moyle 2002).	
lentic or lotic	Environment: Lentic - pertaining to stagnant water, or lake-like; Lotic - moving water, or river-like.	Black crappie reportedly inhabit lentic environments (Moyle 2002).	
Adults			
life span	Approximate maximum age obtained.	The reported maximum age of black crappie is about 13 years (Moyle 2002). The life span of black crappie reportedly ranges from 8 to 10 years (Wang 1986).	
adult length	Indicate: Length at which they first reproduce; average length and maximum length the fish can attain.	Black crappie reportedly mature in their second or third year at 3.9 to 7.9 inches (10 to 20 centimeters) in length (Moyle 2002).	
adult weight	Indicate: Weight at which they first reproduce; average weight and maximum weight the fish can attain.	The maximum size of black crappie is reportedly about 4.9 pounds (2.2 kg) (Moyle 2002).	
physical morphology	General shape of the fish: elongated, fusiform, laterally compressed, etc.	The body shape of black crappie is similar to that of white crappie, except that it is slightly heavier bodied. Black crappie also have a dorsal fin placed fairly far back on the body, with a rounded end that is symmetrical with the end of the anal fin, and a sloping head with a dip about the eye (Moyle 2002).	
coloration	Indicate color, and color changes, if any, during reproduction phase.	The body coloring of black crappie is whitish-silvery with heavy black spotting that is not arranged in vertical bands. The belly is white and the back is dark. Breeding black crappie turn nearly solid black on the anterior halves of their bodies (Moyle 2002).	
other physical adult descriptors	Unique physical features for easy identification.	Black crappie can be distinguished from white crappie by their longer dorsal fin (7 to 8 spines, 15 to 16 rays), the base of which is about the same length as the distance from the fin origin to the middle of the eye. They have 6 spines and 17 to 19 rays in their anal fins, 1 spine and 5 to 6 rays in their pelvic fins, and 38 to 44 scales in their arched lateral lines (Moyle 2002).	
adult food base	Indicate primary diet components.	Larger black crappie reportedly feed predominantly on fish and aquatic insects. It is not uncommon to find large amounts of planktonic crustaceans in the stomachs of black crappie up to 6.3 inches (16 centimeters) in length (Moyle 2002).	
adult feeding habits	Indicate whether plankton eater, algae eater, bottom feeder, piscivorous, active hunter, ambush	California populations feed throughout the year. Peak feeding of black crappie reportedly occurs around noon, midnight, and early morning (Moyle 2002).	

Element	Element Descriptor	General	Feather River Specific
	predator, filter feeder. Night, day, dusk or dawn feeder.		
adult in-ocean residence time	For anadromous species, age when they migrate to the ocean and duration spent in the ocean before returning to freshwater to spawn.		
adult habitat characteristics in-ocean	For anadromous species, description of the ocean habitat utilized: whether along major current systems, gyres, pelagic (beyond continental shelves) and neritic (above continental shelves) zones, etc.		
Adult upstream migration (immigration)			
range of adult upstream migration timing	Time of year adults migrate upstream. If applicable, indicate for various runs.		
peak adult upstream migration timing	Time of year most adults migrate upstream. If applicable, indicate for various runs.		
adult upstream migration water temperature tolerance	Range of water temperatures allowing survival. Indicate stressful or lethal levels.		
adult upstream migration water temperature preference	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.		
Adult holding (freshwater residence)			
water temperature tolerance for holding adults	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Water temperatures greater than 87.8°F (31°C) are reportedly stressful to black crappie, and those above 98.6°F to 100°F (37°C to 38°C) are reportedly usually lethal (Moyle 2002).	
water temperature preference for holding adults	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.	Reported optimal summer water temperatures for black crappie appear to be around 80.6°F to 84.2°F (27°C to 29°C) (Moyle 2002).	

Element	Element Descriptor	General	Feather River Specific
water depth range for holding adults	Reported range of observed (minimum and maximum) water depth utilization.	Water depths where holding adult black crappie are found reportedly range from 7.9 to 49.9 feet (2.4 to 15.2 meters), as observed within twenty-two water bodies in South Dakota (Guy and Willis 1995).	
water depth preference for holding adults	Reported range of most frequently observed water depth utilization.	The optimum water depth range for holding adult black crappie reportedly is 9.4 feet (2.85 meters), as observed within a variety of lakes in Florida (Allen et al. 1998). Black crappie is reportedly primarily a midwater feeder (Moyle 2002).	
substrate preference for holding adults	If bottom dwellers, indicate substrate: mud, sand, gravel, boulders, aquatic plant beds, etc. If gravel, indicate range or average size of gravel.	Adult black crappie reportedly prefer a habitat near vegetation (Wang 1986). Small impoundments reportedly may become overpopulated with black crappies, while populations within natural lakes tend to be low, as observed within a variety of Florida lakes (Allen et al. 1998).	
water velocity range for holding adults	Reported range of observed (minimum and maximum) water velocity utilization.	Holding adult black crappie were reportedly found in water velocities ranging from 0 to 0.1 feet per second (0 to 3 centimeters per second) within the Finger Lakes on the upper Mississippi River (Knights et al. 1995).	
water velocity preference for holding adults	Reported range of most frequently observed water velocity utilization.	The habitat types most selected by black crappie within the upper Mississippi River reportedly had water velocities less than 0.03 feet per second (1 centimeters per second) (Knights et al. 1995).	
other habitat characteristics for holding adults	General description of habitat (e.g. turbid or clear waters, lentic or lotic, presence of aquatic plant beds, debris, cover, etc.).	Black crappie are reportedly usually found in highly localized shoals around large submerged objects during the day, but move offshore during the evening and early morning (Moyle 2002).	
timing range for adult holding	Time of year (earliest-latest) and duration of stay from upstream migration to spawning.		
timing peak for adult holding	Time of year when maximum number of adults are present before spawning.		
Spawning			
fecundity	Average or range in the number of eggs females lay in a spawning season.	Each female black crappie reportedly lays up to 188,000 eggs, depending, in part, on fish size, with 3- to 4-year-old fish producing 33,000 to 42,000 eggs (Moyle 2002).	

Element	Element Descriptor	General	Feather River Specific
		Female black crappie reportedly produce 26,700 to 65,520 eggs, and average 37,796 eggs (Wang 1986).	
nest construction	Location and general description of nest -- substrates, aquatic plants, excavations, crevices, habitat types, etc.	Black crappie nests reportedly are shallow depressions 7.9 to 9.1 inches (20 to 23 centimeters) in diameter, fanned out by males in mud or gravel bottoms in water less than 1 meter deep near or in beds of aquatic plants (Moyle 2002). Black crappie nests reportedly are constructed by the male fish in bottoms of sand, gravel, or mud, near shores with vegetation (Wang 1986).	
nest size	Size and average dimensions of the nest.	Black crappie nests reportedly are usually shallow depressions 7.9 to 9.1 inches (20 to 23 cm) in diameter (Moyle 2002).	
spawning process	Indicate whether nest builder, broadcast spawner, or other.	Reproductive behavior of black crappie is reportedly similar to that of the white crappie, although it has not been described in as much detail (Moyle 2002). Prior to spawning, male black crappie reportedly set up territories over individual nests and guard the same nest through the spawning period, as observed under laboratory conditions (Siefert and Herman 1977).	
spawning substrate size/characteristics	Range of substrates used during spawning (e.g. mud, sand, gravel, boulders, beds of aquatic plants). Indicate presence of plant/wood debris, crevices at spawning sites. If gravel, indicate range of average size.	The spawning substrates used by black crappie reportedly are mud or gravel bottoms (Moyle 2002). Spawning substrates used by black crappie reportedly include, clay, sand, and fine gravel. Black crappie also prefer substrates near aquatic vegetation (Wang 1986).	
preferred spawning substrate	Indicate preferred spawning substrate (e.g. mud, sand, gravel, boulders, plant bed, etc).	The preferred spawning substrate of black crappie reportedly is mud, sand, or gravel near shores with aquatic vegetation (Wang 1986).	
water temperature tolerance for spawning	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Black crappie reportedly begin to spawn once water temperatures exceed 57.2°F to 62.6°F (14°C to 17°C) (Moyle 2002).	
water temperature preference for spawning	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.	The water temperature preference for black crappie spawning reportedly ranges from 64.4°F to 68°F (18°C to 20°C) (Moyle 2002). The water temperature preference for black crappie spawning reportedly ranges from 60.8°F to 69.8°F (16°C to 21°C) (Wang	

Element	Element Descriptor	General	Feather River Specific
		1986).	
water velocity range for spawning	Minimum and maximum speed of water current the spawning fish can tolerate.	Water velocity near black crappie in the Backwater Lakes of the upper Mississippi reportedly ranged from 0 to 0.2 feet per second (0 to 3 centimeters per second) (Knights et al. 1995).	
water velocity preference for spawning	Preferred water current (flow velocity) during spawning.	Water velocity in the areas black crappie moved to within the Backwater Lakes of the upper Mississippi reportedly was generally 0.03 feet per second (1 centimeters per second) or less (Knights et al. 1995).	
water depth range for spawning	Reported range of observed (minimum and maximum) water depth utilization.		
water depth preference for spawning	Reported range of most frequently observed water depth utilization.	Black crappie nests reportedly are shallow depressions fanned out by males in mud or gravel bottoms in water less than 3.3 feet (1 meter) deep (Moyle 2002).	
range for spawning timing	Earliest and latest time of season or year in which spawning occurs.	Black crappie reportedly spawn from March to July (Moyle 2002).	
peak spawning timing	Time of year most fish start to spawn.	Most black crappie reportedly begin to spawn in March or April (Moyle 2002).	
spawning frequency (iteroparous/semelparous)	Semelparous - producing all offspring at one time, such as in most salmon. Usually these fish die after reproduction. Iteroparous - producing offspring in successive, e.g., annual or seasonal batches, as is the case in most fishes.	Black crappie reportedly are iteroparous (Moyle 2002).	
Incubation/early development			
egg characteristics	Shape, size, color, in clusters or individuals, stickiness, and other physical attributes.	Black crappie eggs reportedly are spherical, 0.04 inches (0.93 millimeters) in diameter, adhesive, and egg masses occur in single or small clumps (Wang 1986).	
water temperature tolerance for incubation	Range of water temperatures allowing survival. Indicate stressful or lethal levels.		
water temperature preference for incubation	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.	The preferred water temperature for black crappie incubation reportedly is 64.9°F (18.3°C) (Wang 1986).	

Element	Element Descriptor	General	Feather River Specific
time required for incubation	Time duration from fertilization to hatching. Note: Indicate at which temperature range. Incubation time is temperature-dependent.		
size of newly hatched larvae	Average size of newly hatched larvae.	Black crappie incubation reportedly lasts for 2 to 3 days at 64.9°F (18.3°C) (Wang 1986).	
time newly hatched larvae remain in gravel	Time of year of hatching, and duration between hatching and emergence from gravel.	Newly hatched black crappie larvae reportedly average 0.09 inches (2.32 millimeters) in length (Wang 1986).	
other characteristics of larvae	Alevin -- early life history phase just after hatching (larva) when yolk-sac still present.		
timing range for emergence	Time of year (earliest-latest) hatchlings (larvae and alevins) leave or emerge from the nesting/hatching (gravel) sites.	Newly hatched black crappie larvae reportedly are un-pigmented and remain in the nest (Wang 1986).	
timing peak for emergence	Time of year most hatchlings emerge.		
size at emergence from gravel	Average size of hatchlings at time of emergence.		
egg characteristics	Shape, size, color, in clusters or individuals, stickiness, and other physical attributes.	Size at black crappie emergence reportedly averages 0.1 inches (0.23 centimeters) in length (Wang 1986).	
Juvenile rearing			
general rearing habitat and strategies	General description of freshwater environment and rearing behavior.		
water temperature tolerance for juvenile rearing	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	The water temperature within the Backwater Lakes of the upper Mississippi reportedly ranges from 32.9°F to 42.8°F (0.5°C to 6.0°C) where juvenile black crappie are present (Knights et al. 1995). In a 30 day laboratory experiment, it was reported that mortality of age-0 black crappies was 18 percent at 32°F (0°C), 0 percent at 35.6°F (2°C), and 6 percent at 39.2°F (4°C) (Knights et al. 1995).	
water temperature preference for juvenile rearing	Range of suitable, preferred, or reported optimal water temperatures. Indicate whether literature,	Habitat types with low water temperatures [less than 33.8°F (1°C)] were reportedly the most selected by black crappie within the Backwater Lakes of the upper Mississippi River (Knights et al.	

Element	Element Descriptor	General	Feather River Specific
	observational, or experimental derivation.	1995).	
water velocity ranges for rearing juveniles	Reported range of observed (minimum and maximum) water velocity utilization.	The water velocities within the Backwater Lakes of the upper Mississippi reportedly ranged from 0 to 0.1 feet per second (0 to 3 centimeters per second) where juvenile black crappie are present (Knights et al. 1995). Habitat types with water velocities greater than 0.03 feet per second (1 centimeters per second) reportedly were avoided by black crappie within the Backwater Lakes of the upper Mississippi River (Knights et al. 1995).	
water velocities preferred by rearing juveniles	Reported range of most frequently observed water velocity utilization.	Habitat types with low water temperatures [less than 33.8°F (1°C)] reportedly were the most selected by black crappie within the Backwater Lakes of the upper Mississippi River (Knights et al. 1995).	
water depth range for juvenile rearing	Reported range of observed (minimum and maximum) water depth utilization.		
water depth preference for juvenile rearing	Reported range of most frequently observed water depth utilization.		
cover preferences for rearing juveniles	Type of cover for protection from predators used by rearing juveniles (e.g. crevices, submerged aquatic vegetation, overhanging vegetation, substrate cover, undercover bank, small woody debris, large woody debris).	Juvenile black crappie reportedly prefer quiet, shallow water with patchy vegetation (Wang 1986).	
food base of juveniles	Indicate primary diet components. Also indicate the diet changes, if any, as growth occurs.	Small black crappie young [less than 0.33 inch (10 centimeters) in length] reportedly feed on zooplankton, and larger ones take mostly amphipods, mysid shrimp, and other planktonic crustaceans in the estuary (Wang 1986).	
feeding habits of rearing juveniles	Indicate whether plankton eater, algae eater, bottom feeder, piscivorous, active hunter, ambush predator, filter feeder. Night, day, dusk or dawn feeder. Also indicate change of feeding habits growth occurs.		

Element	Element Descriptor	General	Feather River Specific
predation of juveniles	Indicate which species prey on juveniles.	Newly hatched and young-of-the-year black crappie are reportedly common prey for yellow perch, walleyes, largemouth bass, and northern pike. Older black crappie are reportedly preyed upon mainly by largemouth bass, northern pike, and muskies. Predatory birds, otters, and minks also occasionally eat black crappie (Paulson and Hatch 2002).	
timing range for juvenile rearing	Range of time of year (months) during which rearing occurs.		
timing peak for juvenile rearing	Time of year (months) during which most rearing occurs.		
Juvenile emigration			
time spent in fresh water prior to emigrating	Duration (in years and/or months) from emergence to emigration to the ocean.		
water temperature tolerances during emigration	Range of water temperatures allowing survival. Indicate stressful or lethal levels.		
water temperature preferences during emigration	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		
emigration timing range	Time of year juveniles commence emigration and duration of emigration.		
emigration timing peak	Time of year most juveniles are emigrating.		
size range of juveniles during emigration	Minimum and maximum sizes (inches or mm) of emigrating juveniles. Indicate average size.		
factors associated with emigration	Pulse flows, water temperature changes, turbidity levels, photoperiod, etc.		
Other potential factors			
DO	Levels of dissolved oxygen in water expressed in mg/l tolerated by fish.	In a laboratory study, 100% mortality reportedly resulted when black crappie were held in 1.4 mg/L (Knights et al. 1995). In laboratory experiments, it was reportedly determined that over-wintering of black crappie within DO concentrations of 2.6 mg/L	

Element	Element Descriptor	General	Feather River Specific
		and above did not adversely affect spawning of the black crappie (Knights et al. 1995). Within laboratory conditions, black crappie reportedly avoided all areas with DO concentrations of 1.5 mg/L and lower (Knights et al. 1995).	
pH	Alkalinity/acidity of water (expressed in pH) that fish can tolerate.	Black crappie reportedly can tolerate pH levels of 7.2 to 7.5 (Siefert and Herman 1977).	
turbidity	Indicate turbidity or state of water (e.g., clear water or presence of siltation or organic/inorganic matter in water) that fish can tolerate.	Black crappies reportedly can be found in almost any warm and quiet water within California (Wang 1986). Black crappies reportedly prefer clear, calm, warm water (Paulson and Hatch 2002).	
factors contributing to mortality	e.g. fishing/angling mortality, drastic habitat alterations, unfavorable climatic changes, etc.	Introduction of the Mississippi silverside into Clear Lake (Lake County) has reportedly altered the growth patterns of the black crappie, causing a reduction in growth during the first two years of life (Li et al. 1976). Growth, size structure, and conditions are reportedly poor in small impoundments overpopulated with black crappie (Guy and Willis 1995).	

References

Allen, M. S., M. V. Hoyer, and D. E. Canfield. 1998. Factors Related to Black Crappie Occurrence, Density, and Growth in Florida Lakes. North American Journal of Fisheries Management 18:864-871.

DFG. 2002. State and Federally Listed Endangered and Threatened Animals of California. California Natural Diversity Database. DFG, Habitat Conservation Division, Wildlife and Habitat Data Analysis Branch.

Guy, C. S. and D. W. Willis. 1995. Population Characteristics of Black Crappies in South Dakota Waters: A Case for Ecosystem-Specific Management. North American Journal of Fisheries Management 15:754-765.

Knights, B. C., B. L. Johnson, and M. B. Sandheinrich. 1995. Responses of Bluegills and Black Crappies to Dissolved Oxygen, Temperature, and Current in Backwater Lakes of the Upper Mississippi River During Winter. North American Journal of Fisheries Management 15:390-399.

Li, H. W., P. B. Moyle, and R. L. Garret. 1976. Effect of the Introduction of the Mississippi Silverside (*Manidia audens*) on the Growth of Black Crappie *(Pomoxis nigromaculatus*) and White Crappie (*P. annularis*) in Clear Lake, California. Transaction of the American Fisheries Society 3:404-408.

Moyle, P. B.2002. Inland Fishes of California. Berkeley: University of California Press.

Paulson, N. and J. T. Hatch. nd. Black Crappie (*Pomoxis nigromaculatus*). Available at http://www.gen.umn.edu/faculty_staff/hatch/fishes/black_crappie.html. Accessed on October 15, 2003.

Siefert, R. E. and L. J. Herman. 1977. Spawning Success of the Black Crappie, *Pomoxis nigromaculatus*, at Reduced Dissolved Oxygen Concentrations. Transaction of the American Fisheries Society 106:376-379.

Wang, J. C. S. 1986. Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California: A Guide to the Early Life Histories. IEP Technical Report No. 9. California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, and U.S. Fish and Wildlife Service.